

## Tympanostomy Tube Complications and Efficacy in Children of a Rural Community

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*In the pediatric group practice and the otolaryngologic practice of our rural community, 41 patients were seen in 1984 with 49 episodes of suppurative discharge after tympanostomy tube insertion. Streptococcus pneumoniae was the most common organism after upper respiratory tract infection. Staphylococcus or enteric organisms were most frequently encountered after bathing or swimming. Most patients regained hearing within normal limits. The benefits of tympanostomy tubes in terms of good hearing and reduced incidence of suppurative otitis media outweigh the risk of transitory suppuration for most patients.*

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There has been increasing controversy over the past few years concerning the efficacy and complications of tympanostomy tubes. Stickler recently asked the question, "Could it be that 1 million children each year have unnecessary surgical procedures involving the tympanic membrane?"<sup>1</sup> Others have expressed concern about the complications that occur after tympanostomy tube insertion.<sup>2,3</sup>

Since 1972, the effectiveness of tympanostomy tubes has been measured in a number of studies by comparing the results after unilateral tube insertion in an operated versus the control ear. Kilby and co-workers observed 52 children for two years who had bilateral myringotomy with insertion of a tube on only one side and concluded that there was no significant difference in hearing thresholds or in the persistence of middle ear fluid (approximately 30% in either), but that thin tympanic scars were more frequent after tube insertions.<sup>4</sup> In a report from Wales, Brown and colleagues found a 42% incidence of tympanosclerosis and a 13% incidence of thin scars after tubes, compared with 0% in control ears five years after unilateral tube insertion.<sup>5</sup> They found no difference in hearing at that time, but did note much better hearing during the first year after tube insertion. Lildholdt reported similar results from Denmark after a five-year follow-up of 150 children who had a total of 1,700 checkups.<sup>6</sup>

The incidence of complications after tympanostomy tube insertion has been reported from such various centers as Israel, Europe, the United States, Canada and Japan. The reported incidence from representative papers is summarized in Table 1. From the standpoint of etiology, Smelt and Yeoh's

report is particularly interesting.<sup>14</sup> They found a lower incidence of suppuration in patients who swam (7.5%) than in those who did not (17.6%). For many years clinicians have been convinced that water in the ear can lead to suppuration after tympanostomy tubes have been inserted. A semipermeable tube to permit passage of air, but not water, was designed to prevent this problem and good results in preventing discharge after tube insertion have been reported with its use.<sup>15</sup>

Tympanostomy tubes are used for managing the "otitis media-prone child." Gebhart defined the condition as three episodes of acute purulent otitis media in six months in children younger than 3 years of age.<sup>10</sup> He compared a group of patients treated with tubes with one treated with antibiotics and found a much higher incidence of suppurative otitis in the group treated without tubes. There were 36 episodes of otitis media in 25 of 41 patients treated with tubes. In an article that was severely criticized by Paradise,<sup>16</sup> Liston<sup>17</sup> concluded that the use of sulfisoxazole twice a day was effective and safe for the prophylactic treatment of recurrent suppurative otitis media. Despite the disagreement found in the literature, most clinicians advocate prophylactic antibiotic therapy for these patients and reserve tubes for patients who "break through" prophylactic antibiotic management.

### Patients and Methods

During 1983, 63 pediatric patients in Price, Utah, were treated by insertion of tympanostomy tubes. They were followed until December 31, 1984. Patients who would be unusually predisposed to ear problems such as those with

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craniofacial anomalies, hypogammaglobulinemia of infancy or an underlying chronic disease such as diabetes mellitus were excluded from the study group. Three adults had tubes inserted during this period and were not included. They had no problems with the tubes. The indications for insertion included recurrent suppurative otitis media, hearing loss due to negative middle ear pressure, chronic middle ear effusion or some combination of these problems, as detailed in Table 2. Some patients also had adenoidectomy or adenoidectomy and tonsillectomy, depending on whether there was a history of chronic nasal obstruction, frequent severe sore throats or both. The tubes were inserted through a radial, anterior myringotomy under general anesthesia. Suction was used to remove fluid from the middle ear only if it interfered with placement of the tubes. No particular effort was made to "empty" the middle ear of thick mucoid secretions. Either a split T-tube (Goode) or an arrow tube (Lindeman-Silverstein) was used. (The latter was inserted with the flanged end in and the arrow directed outwards.)

Tympanostomy tubes were used for otitis media-prone children if prophylactic antibiotics failed. For prophylaxis, one of us (D.A.H.) prefers a regimen of oral penicillin suspension daily and the pediatric group prefers the use of sulfisoxazole or the combination of trimethoprim and sulfamethoxazole. For children with chronic middle ear effusion, a waiting period of six weeks to three months was used between diagnosis and insertion of tubes. During this time, one

of us (D.A.H.) prescribed diphenhydramine hydrochloride (Benadryl) elixir at bedtime daily, and the pediatric group prescribed an antibiotic, most often amoxicillin.

During 1984, all patients with complications attributable to tubes were studied by sequential audiometrics, tympanometry and culture (when infection was present). Most patients in this rather isolated rural community with such complications were seen in either the otolaryngologic or the group pediatric practice. We asked whether the patients had been swimming, had bathed or had had an upper respiratory tract infection. Whenever possible, we did a bacteriologic culture of specimens from each infected ear and correlated the results with the history of water in the ear or of an upper respiratory tract infection. The swabs were immediately plated out on three media: MacConkey's, chocolate agar and blood agar. They were incubated at 37°C and appropriate identification procedures were used by Noah Anderson, a microbiologist.

## Results

In Table 2 the complication rate is compared with the indications for tympanostomy tubes. Of the 63 patients who had tubes in 1983, 26 had suppuration and 1 had a persistent perforation during the follow-up period, which extended until December 31, 1984. The rate of suppurative discharge was 41%. It was greater in patients who had tubes for middle ear effusion than in those whose indication was recurrent suppurative otitis media. Only four patients had tubes for persistent negative pressure (type C tympanogram) associated with hearing loss, but suppurative discharge developed in all four.

Our results during 1984 are summarized in Table 3. We saw a total of 41 patients who had suppurative discharge from one or both ears after tympanostomy tube insertion. Three patients had persistent perforations (but hearing within normal limits) and one had granulation tissue at the site of the tube for several weeks. Four patients had two episodes of suppuration, one had three and one had four episodes of unilateral or bilateral discharge. The 41 patients had a total of 49 episodes of suppurative discharge, treated by either D.A.H. or the pediatric group. Four patients had cloudy fluid in the middle ear at the time of the surgical procedure and began discharging almost immediately after the operation. These were classified as having "postoperative" infections.

Following an upper respiratory tract infection, *Strepto-*

TABLE 1.—Incidence of Suppurative Discharge After Tympanostomy Tube Insertion

Study	Incidence, Percent
Balkany et al <sup>2*</sup>	12.0
Birch and Mravec <sup>7</sup>	15.0
Draf and Schulz <sup>8</sup>	12.5
Eliachar et al <sup>9</sup>	22.0
Gebhart <sup>10†</sup>	45.0
Herzon <sup>3</sup>	21.4
Kokko and Palva <sup>11</sup>	5.0
Lildholdt <sup>6</sup>	30.0
Luxford and Sheehy <sup>12</sup>	19.0
McLelland <sup>13</sup>	19.9
Smelt and Yeoh <sup>14</sup>	Swimmers 7.5 Non-Swimmers 17.6
Hilding and Ammerman	41.0

\*Balkany and co-workers reported data from the first four weeks postoperative.

†Gebhart's patients were all "otitis media-prone" children.

TABLE 2.—Indication for Tympanostomy Tube Insertion\*

Complication Category	Patients, Number (N = 63)			
	Impaired Hearing and Fluid	Impaired Hearing, Negative Pressure	Recurrent Infection	Impaired Hearing, Fluid and Recurrent Infection
No complication	23	0	8	5
Complications	17	4	4	2
Totals	40	4	12	7

\*In all, 63 patients had tympanostomy tubes. Of 40 patients who had tubes placed because of impaired hearing and fluid, 17 had problems, but all 4 patients whose indication was impaired hearing and a negative middle ear pressure had subsequent problems. 3 had otorrhea and 1 had a persistent perforation—too few for statistical analysis.

TABLE 3.—Etiology and Organisms Cultured From 41 Patients\* Seen During 1984

Organism	Etiology			
	Bath or Swim	URI	Post-operative	Unknown
<i>Staphylococcus</i>	5	0	1	3
<i>Streptococcus pneumoniae</i>	0	7	0	0
<i>Hemophilus influenzae</i>	1	0	2	1
<i>Pseudomonas</i>	2	0	1	0
<i>Streptococcus</i> type A	0	1	0	0
<i>Enterobacter cloacae</i>	1	0	0	0
<i>Klebsiella pneumoniae</i>	1	0	0	0
Mixed	1	1	0	2
Unknown	5	10	0	4
Total	16	19	4	10

URI = upper respiratory tract infection

\*In all, 49 episodes of suppurative discharge occurred in 41 patients in 1984.

*coccus pneumoniae* was the most common organism cultured. *Staphylococcus aureus*, *Staphylococcus epidermidis* or enteric organisms were encountered after swimming or "dunking" the head in bathwater.

Most patients recovered hearing within normal limits and an infection-free ear after treatment. One patient required admission to hospital, removal of the tympanostomy tube and intravenous administration of antibiotics (ticarcillin disodium and gentamicin sulfate). Several patients were treated with systemic antibiotics such as amoxicillin or one of the cephalosporins, but most had only topical antibiotic-steroid ear drops (Cortisporin\* or Coly-Mycin S otic†) and regular cleaning as treatment. In the 1984 group of patients, there have been only one bilateral recurrence of middle ear effusion and two unilateral during the study period ending December 31, 1984. One patient had fluid in one ear and negative pressure in the other with bilateral hearing loss, and one patient had unilateral loss due to fluid. From previous experience, and from results of other studies, we expect about a 30% recurrence rate of middle ear effusion and hearing loss after the tubes have extruded.

## Discussion

We observed a high rate of suppurative discharge after tympanostomy tube insertion—41%—compared with that previously reported. Only four episodes occurred in the immediate postoperative period, so it is unlikely that our high rate of suppurative discharge can be blamed on poor surgical technique. A more likely explanation is that almost all of our patients were returned to one of our offices for the care of complications.

Despite the high incidence of transitory suppurative discharge, the hearing results were better than have generally been reported in the literature. Authors have agreed that hearing is improved for patients by intubation for the period before extrusion. Most of our patients retained the tubes for more than six months (a detailed study of the duration of tubes before extrusion is in progress). Analysis of results reported by Lildholdt<sup>6</sup> and by Brown and associates<sup>5</sup> shows that many of their patients had extruded their tubes at three months and most by six months.

Smelt and Yeoh<sup>14</sup> concluded that water in the ear from swimming was not an important factor in the cause of discharge after tympanostomy tubes. They reported the startling result of a higher incidence of discharge in nonswimmers than in swimmers. We found that discharge started soon after water was introduced into the ear during swimming or after immersion of the head in bathwater. The organisms cultured in specimens from the ears of children with a history of water in the ear were derived from the skin or were enteric organisms. Of interest also, the organisms after a history of upper respiratory tract infection were quite different.

\*A combination suspension that contains polymyxin B sulfate, neomycin sulfate and hydrocortisone.

†A combination suspension that contains neomycin, hydrocortisone acetate and acetic acid.

There is disagreement concerning the importance of hearing loss due to middle ear effusion on language and educational development. We did not measure improvement in educational performance, but audiograms showed immediate improvement, which persisted throughout the study period for most patients except during episodes of suppurative discharge. Both parents and physicians are convinced that the children benefited from better hearing in school and at home.

## Conclusions

- In our small rural community we observed a rate of 41% suppurative discharge after tympanostomy tube insertion. This rate is higher than that reported by most authors. We believe that comprehensive follow-up is the explanation for the observed high complication rate.

- Water in the ear after swimming or while bathing is a significant etiologic factor in discharge after tympanostomy tube insertion. Organisms from the skin or enteric organisms are common in children with a history of water in the ear. After upper respiratory tract infections, the most common organism is *Streptococcus pneumoniae*.

- Almost all our patients recovered from complications after tympanostomy tube insertion, except for two who had small persistent perforations, and almost all had normal hearing at the end of the study period. We believe that the benefits conferred by tympanostomy tubes for selected patients outweigh the risks.

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